# THE PLANT DISEASE REPORTER

Issued By

## THE PLANT DISEASE SURVEY

Division of Mycology and Disease Survey

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

AGRICULTURAL RESEARCH ADMINISTRATION

UNITED STATES DEPARTMENT OF AGRICULTURE

Volume 34 Number 8

August 15, 1950

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Division of Mycology and Disease Survey serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

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THE PLANT DISEASE SURVEY
DIVISION OF MYCOLOGY AND DISEASE SURVEY

Plant Industry Station — Beltsville, Maryland
Volume 34 — August 15, 1950 — Number 8

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# CANKERS OF LINDEN AND REDBUD

Horace V. Wester, Ross W. Davidson, and Marvin E. Fowler[1]

The linden is an important shade tree in the National Capital Parks of Washington, D. C., ranking fourth, following elm, oak, and sycamore. Major diseases now attacking elm, oak, and sycamore in the eastern and midwestern United States indicate that lindens may be planted more extensively in the future than in the past. The canker stain disease of sycamore caused by species of Endoconidiophora was discovered in Washington in 1939. The Dutch elm disease caused by Ceratostomella ulmi was first noted in the city in 1947. The destructive phloem-necrosis virus disease of elm and the serious oak wilt disease, caused by Chalara quercina, now widespread in the Midwestern States, may reach Washington at any time.

Figure 1. Several type 1 cankers on trunk of gray linden (Tilia neglecta).

Except for canker infections and heartrots, lindens in the United States appear to be relatively disease free. Dodge and Rickett (1, pp. 574-575) report Tilia as host of the canker-producing fungus, Nectria cinnabarina. Welch (2) found Nectria canker on basswood unrelated to basswood-dying in New York. The cankers observed on linden in Washington by the writers are not of the Nectria type and do not appear to have been studied before. Some of these cankers were observed to be destructive to individual branches, and occasionally appeared highly destructive to entire trees. Realizing the increased importance of lindens for this area, the writers have made some preliminary studies of the cankers. These studies included a survey of lindens for canker infections in the National Capital Parks, and inoculations, with the object of establishing the cause of the most important linden canker, designated as type 1. Botryosphaeria ribis was commonly isolated from type 1 canker. Weiss (4, p. 425) lists B. ribis as occurring on branches of Tilia americana. Watson (3) has established B. ribis chromogena as the cause of the canker on eastern redbud (Cercis canadensis). To determine whether linden type 1 canker and the canker on eastern redbud were interrelated, cross-inoculation tests were made. The Chinese redbud, Cercis chinensis, which as far as known is not affected by the eastern redbud canker organism, was also tested for susceptibility to infection by B. ribis isolates from type 1 linden canker and eastern redbud.

## Survey of Lindens for Cankers

Twelve species of linden are represented in the National Capital Parks, eight of which were found to be affected by one or two of four different types of cankers (Table 1), designated as types 1, 2, 3, and 4. The cankers are briefly described in Table 1. Type 1 canker (Figures 1 and 2) was found on Tilia americana, T. heterophylla, and T. neglecta, which are native American species, while types 2, 3, and 4 were found on one or two of the European species, T. cordata, T. europaea, T. petiolaris, and T. tomentosa. No cankers were found in three trees of T. dasystyla, one tree of T. euchlora, two trees of T. moltkei, and 73 trees of T. platyphyllos. Only trees of the latter species were sufficiently numerous to indicate significant resistance to canker.

Type 1 canker was usually much larger than the other types, and was much more injurious to individual trees. Old cankers of type 1 frequently were 6 to 12 inches in diameter. Occasionally large cankers of this type were found to have girdled and killed large leaders, the girdling usually resulting from two or more cankers growing in close proximity around a limb. Type 1 canker

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Figure 2. Type 1 canker on small stem of gray linden (Tilia neglecta).

was found affecting 26 percent of 50 trees of T. americana, 6.9 percent of 29 trees of T. heterophylla, and 20.4 percent of 108 trees of T. neglecta.

Type 2 canker appeared to be of relatively minor importance. Single cankers, about 2 inches wide and 4 inches long occurred only on one of five trees of T. cordata and one of 198 trees of T. europaea.

Type 3 canker was found only on young trees of T. europaea and appeared to develop only when the trees were growing under adverse conditions, such as in heavy hard soil, or were retarded by transplanting. Cankers of this type were most frequent on the trunk and sometimes were up to about 3 inches wide and 12 inches long. Of 198 trees of T. europaea, 12.6 percent were affected by type 3 canker.

Type 4 canker was found very commonly on large trees of T. petiolaris and T. tomentosa. This canker affected 71.4 percent of 14 trees of T. petiolaris and 40 percent of 27 trees of T. tomentosa. Infected trees of T. petiolaris had an average of 39.4 cankers per tree while affected trees of T. tomentosa had an average of 19.5 cankers per tree. This type of canker, although relatively small, appears to weaken trees when numerous, which makes it appear advisable to prune out affected branches at timely intervals.

## Isolations and Inoculations

A number of isolation attempts from type 1 cankers yielded several fungi and bacteria. A large proportion of the isolates proved to be the Dothiorella stage of Botryosphaeria ribis; one was Diplodia theobromae; and the bacteria were not identified. Three cultures of the Botryosphaeria, one of Diplodia theobromae, and a bacterium were selected for use in preliminary inoculations. Later it was thought desirable to test the redbud fungus by inoculation on native redbud and on the Chinese redbud on which no cankers have been observed, and by cross inoculation on linden.

The inoculation technique consisted of inserting inoculum under sterile conditions into slanting shallow knife cuts about 1 inch long into the superficial xylem of branches about 1 to 2 inches in diameter, and covering the wounds with moist sterile cotton held in place by scotch type.

The inoculations were made over a three-year period. The first year only two species of linden were tested and the second year additional species and varieties were included. The third year was devoted mostly to a redbud and linden cross-inoculation study. Inoculations were made in the early spring (March-April) and examined in the fall. The first year's inoculations were examined for two succeeding years.

## Results of Inoculations

A summary of the results is given in Figure 3. Isolate No. 12, which was a chromogenic strain, caused larger cankers than the other two Botryosphaeria isolates. It also gave more consistent results. Diplodia theobromae was very similar to Botryosphaeria No. 12 in its cankering

Table 1. Survey of cankers on linden, National Capital Parks, Washington, D. C., 1944

| Description of canker | Species of linden[a] affected | Average D.B.H. inches | Total number trees | Percent trees cankered | Average number cankers/tree | Location of cankers |
|---|---|---|---|---|---|---|
| Type 1. Bark area usually first raised, later becoming sunken, dead bark often exfoliating exposing targetlike rings on wood beneath. | Tilia americana | 20.9 | 50 | 26.0 | 6.2 | Trunk and branches |
| | Tilia heterophylla | 16.0 | 29 | 6.9 | 6.0 | " |
| | Tilia neglecta | 17.4 | 108 | 20.4 | 17.7 | " |
| Type 2. More or less closed, bordered by heavy bark folds. | Tilia cordata | 7.5 | 5 | 20.0 | 1.0 | Branch |
| | Tilia europaea | 5.4 | 198 | 0.5 | 1.0 | " |
| Type 3. Flat slightly sunken dead bark areas | Tilia europaea | 5.4 | 198 | 12.6 | About 3 | Trunk and branches |
| Type 4. Small dead bark areas, bark splitting and breaking apart with age, commonly surrounding dead stubs. | Tilia petiolaris | 23.2 | 14 | 71.4 | 39.4 | Branches |
| | Tilia tomentosa | 23.5 | 27 | 40.0 | 19.5 | " |
| No cankers | Tilia dasystyla | 8.0 | 3 | 0.0 | - | - |
| | Tilia euchlora | 6.3 | 1 | 0.0 | - | - |
| | Tilia moltkei | 23.4 | 2 | 0.0 | - | - |
| | Tilia platyphyllos | 16.4 | 73 | 0.0 | - | - |

[a]Dr. Leon Croizat of the Arnold Arboretum checked the identification of various linden species reported in this paper.

ability, whereas the bacterium and the check injuries using no organism gave consistently negative results.

The redbud Botryosphaeria No. 16 and linden culture No. 12 both caused cankering of Chinese and native redbud, although cankers formed by No. 16 were slightly larger than those caused by No. 12.

Several inoculations were made with the redbud culture No. 16 on Tilia neglecta and caused cankers of about the same size as No. 12. The average size of such cankers could not be given accurately because the tags were lost. Several series of two fungus inoculations per branch with a check injury between them consistently resulted in two cankers, with a negative result at the check position.

Pycnidia developed on many of the cankers during the first summer season following inoculation but such fruiting was carefully checked in only a few cases. This was true for both Diplodia and Botryosphaeria.

A few of the cankers were larger when measured at the end of the second summer but in most cases cankers were smaller at the end of the second summer. There was also some indication that any recorded increase in size during the second season was due to failure to determine the limits of cankered areas accurately at the first examination.

## Discussion

The results of the inoculation studies indicate that Botryosphaeria ribis and Diplodia theobromae isolates from type 1 canker on Tilia neglecta may cause cankers on T. neglecta, T. cordata, T. americana, T. platyphyllos, and T. europaea. As B. ribis was isolated commonly from type 1

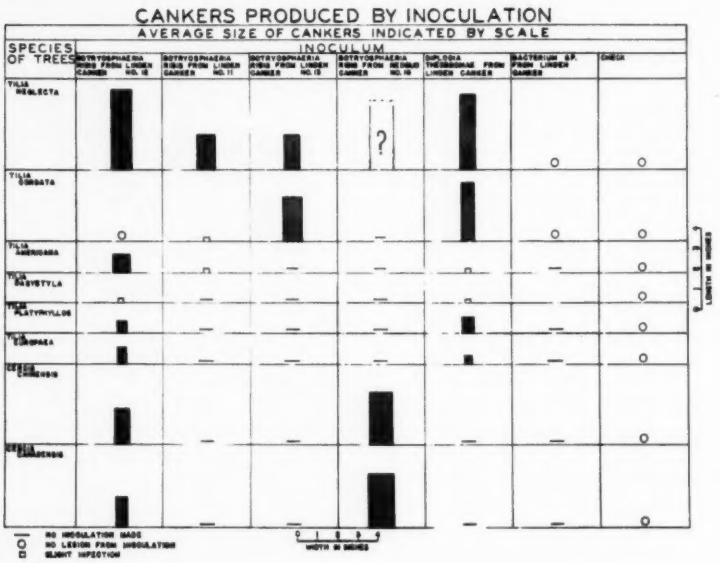


Figure 3. Chart illustrating the results of artificial inoculations with several organisms on linden and redbud.

canker and D. theobromae only once, the former appears to be of greater significance as the probable cause of type 1 canker than the latter, although one or both fungi may be involved. The cankers produced by the inoculations, however, were not like type 1, but were similar to type 2. The difference between the appearance of natural type 1 canker and those caused by the inoculations may possibly be related to the manner of infection. Possibly under natural conditions the cortex is first infected, which may induce the cambium to produce an excessive amount of cortical tissue before being killed. In the artificial infections the inoculum was placed in shallow knife-cut wounds, which penetrated into the superficial xylem layer, thereby exposing the cambium to immediate infection. Exposing the cambium to direct infection probably resulted in its becoming killed too rapidly to permit it to stimulate the production of abnormal cortical tissue, which appears to be characteristic in the development of type 1 canker.

Botryosphaeria ribis is pathogenic on a variety of host plants and occurs in a variety of strains. The fungus, however, does not appear to have been reported before as parasitic on linden. It was found in these studies that B. ribis isolated from eastern redbud developed cankers readily when inoculated on T. neglecta, and that an isolate of the fungus from T. neglecta likewise developed cankers readily on eastern and Chinese redbuds. Larger cankers usually were produced when the isolates were inoculated on their own hosts rather than on other host species. Various isolates of B. ribis from T. neglecta also produced cankers having a wide range of sizes when inoculated on its own host. All these differences in host response to the various Botryosphaeria isolates may be attributed to strain differences.

It is possible that all four types of cankers noted in the linden canker survey are caused by one or more strains of Botryosphaeria ribis and that the different types of cankers noted in the field are characterizations of host response to the pathogen. It appears noteworthy that the different types of linden canker were found on one or several closely related species of linden. Type 1 canker occurred only on the closely related native linden species T. neglecta, T. americana, and T. heterophylla. Canker type 2 was recognized only on T. cordata and T. europaea, which are closely related European species. Type 3 canker occurred only on T. europaea growing in unfavorable environmental conditions. The latter type of canker, however, was very similar to the Botryosphaeria canker on eastern redbud. Type 4 canker was found only on T. tomentosa and T. petiolaris, which are closely related European species.

The linden species inoculated showed a wide range of susceptibility to infection by the Botryosphaeria and Diplodia isolates. T. neglecta proved most susceptible on the basis of size of can-

kers produced, while the European species T. platyphyllos, T. europaea, and T. dasystyla proved highly resistant. The linden canker survey showed T. neglecta to be highly susceptible to canker infection, whereas T. platyphyllos, T. europaea, and T. dasystyla were free or practically free of cankers, except that type 3 was commonly found on T. europaea, a condition which, however, was associated only with adverse growing conditions. On the basis of the above studies it would seem advantageous to plant the more desirable types of the above apparently canker-resistant European lindens in Washington rather than the native species T. neglecta, T. americana, and T. heterophylla, which have been found highly susceptible to canker infection.

The development of cankers, about as readily on Cercis chinensis as on C. canadensis from isolate No. 16 of Botryosphaeria ribis cultured from the latter, indicates that this pathogen is about equally virulent on both host plants. The absence of naturally occurring Botryosphaeria canker on Cercis chinensis in the field indicates that favorable conditions for natural infection on this species apparently are lacking.

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NATIONAL CAPITAL PARKS, U. S. DEPARTMENT OF THE INTERIOR, WASHINGTON, D. C., AND DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, BELTSVILLE, MARYLAND

# CUCURBITARIA ELONGATA ASSOCIATED WITH A CANKER OF HONEYLOCUST IN OHIO

Jesse D. Diller and Ross W. Davidson

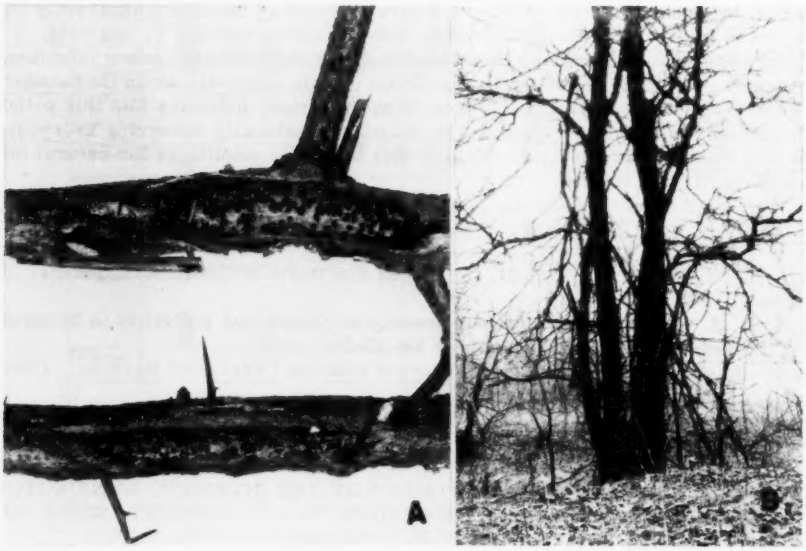


Figure 1. Honeylocust canker. A. Fruiting bodies on twig and branches. B. Characteristic sloughing-off of branches killed by canker.

In the spring of 1939 attention was called to a canker disease of honey locust (Gleditsia triacanthos) near Urbana, Champaign County, Ohio, along the banks of the Mad River. The cankers were observed on most of the trees in several small clumps in only one locality. It has been observed in several succeeding years and appears to continue to spread to new growth on these trees. The cankers appeared on small twigs, but persisted and enlarged somewhat, becoming sunken with bark adhering as the diameter increased (Fig. 1, A). They are usually centered around the thorns or leaf spurs, and they are very abundant on some trees. Killed crown branches slough off (Fig. 1, B).

Fruiting bodies of the fungus Cucurbitaria elongata, or the pycnidial stage Hendersonia sp., have been consistently associated with the cankers. Usually both the perithecial and the pycnidial stages are present in the same stromata. Cucurbitaria elongata has frequently been collected in various localities on dead twigs of blacklocust (Robinia pseudoacacia), and sometimes occurs on dead areas of living stems of this host but has never been found consistently associated with cankers.

Potted seedlings of 18 honeylocust and 13 black locust were inoculated in the greenhouse with a culture of Cucurbitaria elongata. None of these plants developed cankers.

Further work is needed to determine the relationship of Cucurbitaria elongata to these cankers on honeylocust near Urbana, Ohio.

DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

# SUPPLEMENTARY SURVEY FOR SPOT ANTHRACNOSE OF FLOWERING DOGWOOD IN MARYLAND AND VIRGINIA

R. A. Jehle and Anna E. Jenkins

Figure 1. Spot anthracnose on bracts of flowering dogwood, La Plata, Maryland, April 28, 1949. Photograph by W. F. Jeffers.

The survey for flowering dogwood (Cornus florida L.) spot anthracnose, caused by Elsinoë corni Jenkins & Bitanc. (3), conducted in 1948 particularly in Maryland was begun only in mid-June (2). As the survey has been continued during 1949-50 emphasis has been placed on obtaining records of the disease beginning with the new season's growth. Supplementary data resulting from this survey, as well as from a consultation relative to what proved to be spot anthracnose on flowering dogwood on a residential property at Snow Hill, Maryland, are assembled in Table 1.

As the table shows and as was expected, spot anthracnose lesions appear on the new season's growth as it develops. Not only was the disease in evidence on bracts at La Plata, Maryland, on April 28, 1949, but it was severe and disfiguring (Fig. 1). It was this aspect of the trouble on flowering dogwood trees at Atlanta, Georgia, that brought it to the attention of plant pathologists in that State (cf. 1, 3, 4 and 5[1]) and again this season (1).

Wheaton, Montgomery County, Maryland, constituted the most northerly record of the disease in 1948. Its distribution several miles farther north is established by the present records from the vicinity of Rockville in the same county.

The flowering dogwood trees on the residential property at Snow Hill consist of one large, approximately 25-year-old tree with white bracts, and younger trees, some with white, others with pink bracts. The foliage of the older tree was abundantly infected. This had not been sprayed. As a control for the then unidentified malady on the younger trees these had been sprayed early in the season with Bordeaux Mixture and later with equal parts of Fermate and Dentate. These sprayed trees were only moderately infected and the owners were of the opinion that the

[1]In this reference (p. 99) the date 1947 should be corrected to 1948.

Table 1. Records of spot anthracnose of flowering dogwood in Maryland and Virginia, spring 1949 to July 5, 1950.

| County* | Location | Date** | Season's growth affected |
|---|---|---|---|
| Charles | La Plata | Apr. 28, 1949 | Bracts |
| Dorchester | Hurlock, vicinity | June 1, 1949 | Leaves and stems |
| Montgomery | Rockville, 2 1/2 mi. south | Sept. 16, 1949 | Leaves and ripe fruit |
| | " 2 mi. north | Sept. 30, 1949 | Leaves and stems |
| | " " " " (same spot as above) | May 12, 1950 | Bracts |
| Wicomico | Hebron, vicinity | May 22, 1950 | Leaves and stems, with leaf distortion |
| | Salisbury, Maryland University Farm | May 17, 1949 | Leaves and stems |
| | Salisbury, Maryland University Farm | June 13, 1949 | Leaves, stems, and young fruit |
| Worcester | Pocomoke, vicinity | June 2, 1949 | Leaves and stems, severe leaf distortion |
| | Stockton, on road to Pocomoke | June 2, 1949 | As above |
| | Stockton, on road to Girdletree | June 2, 1949 | Leaves, stems, and young fruit |
| | Snow Hill, residential property | June 14, 1950 | Leaves and stems of both white, and pink flowering dogwood |
| | " " " " | July 5, 1950 | |
| Madison, Va. | Rochelle (city) | June 9, 1950 | Leaves and stems |
| | Rochelle, 1/2 mi. south | June 9, 1950 | " " " |

* In Maryland unless otherwise indicated.

** Specimens representing these dates have been deposited in the herbarium of the Department of Plant Pathology, University of Maryland, and in the Mycological Collections of the Bureau of Plant Industry.

disease was under control. These younger trees had been purchased about six years before at a Maryland nursery. At this particular nursery all flowering dogwood stock is purchased in States to the south, and at present none is growing in the nursery.

In Virginia in 1949 a roadside survey of flowering dogwood between Brandy, Culpeper County and Washington, D. C., yielded no records of the spot anthracnose.

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DEPARTMENT OF PLANT PATHOLOGY, UNIVERSITY OF MARYLAND AND DIVISION OF MYCOLOGY AND DISEASE SURVEY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING

## LEAF DISEASES OF DOGWOOD SEVERE THIS YEAR IN APPALACHIANS

George H. Hepting

On July 6, 1950, leaves of dogwood (Cornus florida), heavily infected with spot anthracnose, caused by Elsinoë corni, were collected by officials of the Blue Ridge Parkway, and sent to the Asheville office of the Division of Forest Pathology for diagnosis.

The collections were made at Trail's Cabin, Smart View Park, Blue Ridge Parkway, near Floyd, Virginia. Affected trees developed a sparse, brownish appearance in the lower crowns. Upper crowns were affected less. Superintendent Sam P. Weems of the Parkway writes, "Approximately 50 percent of the trees in the Parkway south of Roanoke are infected and on Section 1-U it is epidemic."

Another leaf disease, caused by Ascochyta cornicola, that causes spots and shriveling of entire leaves of dogwood, has been epidemic through the mountain areas of Virginia and North Carolina in 1950. This same disease was epidemic in 1942 and had not been conspicuous enough to be noticed, between those years.

DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, ASHEVILLE, NORTH CAROLINA, JULY 21.

Note. Still more extensive distribution of flowering dogwood spot anthracnose in the Appalachians is shown by two records of last year that have come to my attention: In June a correspondent at Lynchburg, Virginia, transmitted to S. B. Fenne diseased leaf samples of flowering dogwood that proved to be affected by the spot anthracnose. Word has come from Harold T. Cook that last autumn (September 18) at Panorama (intersection of U. S. Route 211 and Skyline Drive) flowering dogwoods were abundantly attacked by this disease. A.E.J.

# A NOTE ON LEPTOSTROMA HEDGCOCKII DEARN.

John S. Boyce, Jr.[1]

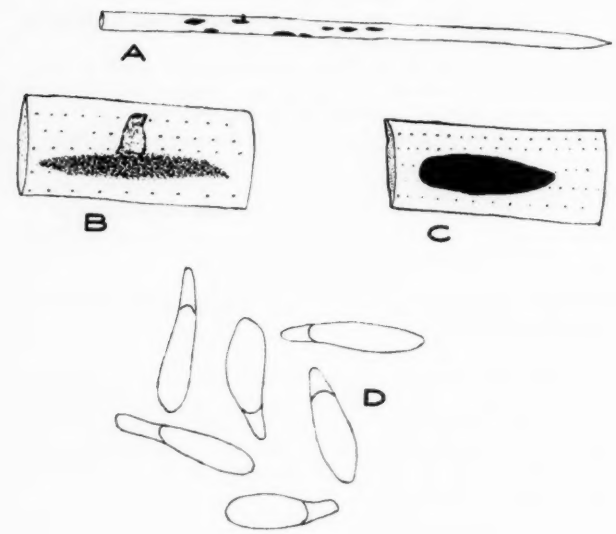


Figure 1. Leptostroma hedgcockii Dearn. A: portion of a slash pine needle showing the occurrence of pycnidia. B: pycnidium with extruding spore mass. C: pycnidium prior to spore discharge. D: the one-septate conidia, camera lucida drawing. E: camera lucida sketch of a free hand section through a pycnidium.

In the spring of 1949 a striking pycnidial fungus was collected on green needles of a slash pine tree (Pinus caribaea More.) near Callahan, Florida. This fungus was subsequently identified as Leptostroma hedgcockii Dearn., which was first described in 1928 (3). Its perfect stage is known as Hypoderma hedgcockii Dearn. (2). Hysterothecia of the latter occur as shining, black, elliptical areas on green pine needles. Unlike other Hypodermas the ascus usually contains four spores of normal size instead of eight ascospores.

The perfect stage has been collected on needles of Pinus caribaea in Florida and North Carolina, Pinus clausa Vasey in Florida, Pinus echinata Mill. in North Carolina and Virginia, Pinus palustris Mill. in Florida, Pinus rigida Mill. in North Carolina, and Pinus virginiana Mill. in Maryland and Tennessee (1). It is among those hypodermataceous fungi which may be responsible for a premature shedding of the needles attacked by them. Apparently the conidial stage, L. hedgcockii, is more common than the ascigerous state (3).

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[1]Formerly at Duke University where study reported in this paper was done. Now with the Division of Forest Pathology, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Asheville, North Carolina.

The conidia, which are borne in sporocarps similar to the hysterothecia, are snow-shoe-shaped in contrast to the usual ovoid or oblong to allantoid spores of the genus Leptostroma (4). The writer's collection of L. hedgcockii differs from the fungus described by Dearness in one important respect. Evidently he assigned the fungus to Leptostroma because his material contained one-celled conidia. Many conidia in the writer's collection are distinctly two-celled. Among these spores septations occur near the narrow ends. A few conidia were observed to germinate in distilled water drops on glass slides within 36 hours at room temperature. One germination hypha, less commonly two, grew out from the wider cell of each conidium.

Inasmuch as spore septation is an important diagnostic feature the writer wishes to call this previously unnoted occurrence of septation of the conidia of L. hedgcockii to the attention of mycologists and plant pathologists, so that this character may be recognized and confusion thereby avoided. Descriptive features of the fungus are illustrated in Figure 1.

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FORMERLY AT DUKE UNIVERSITY, NOW WITH THE DIVISION OF FOREST PATHOLOGY, BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING, ASHEVILLE, NORTH CAROLINA

## MEADOW NEMATODES (PRATYLENCHUS SP.) ON MAZZARD CHERRY AND FORAGE PLANTS AND WEEDS IN NURSERY ROTATIONS

Roy A. Young, D. C. Torgeson and C. G. Anderson[1]

Mazzard cherry (Prunus avium) seedlings are commonly used as understock for flowering cherry and for sweet and sour cherry varieties. In an average growing season in the Willamette Valley Mazzard seedlings attain a height of 12 to 24 inches. Failure of seedlings to make normal growth has been observed since 1946 in two areas in Multnomah County, Oregon. Seedlings in those areas grew normally in the spring but in early summer terminal growth stopped on many of the plants and no further growth occurred during the remainder of the summer. Lack of growth was the only indication on the aboveground parts of the plant of an abnormal condition. However, small brown cortical lesions were discernible with the naked eye on roots of the retarded plants. Numerous fungi were isolated from the lesions, but none consistently. Examination of such roots, using the lactophenol and acid fuchsin method (3), modified to the extent that the roots were immersed in the staining solution at 160° F. for 30 seconds, revealed the presence of members of the meadow nematode group (Pratylenchus sp.)[2].

In an attempt to determine whether the retardation in growth of Mazzard cherry seedlings was due to a parasitic condition, soil treatment plots were laid out in September 1948 on soil in which Mazzard seedlings had been markedly retarded in growth during the previous year. Three plots were treated with chloropicrin, three left untreated, and all were subsequently planted with Mazzard cherry seed. Owing to unusual snow conditions the plots were flooded in February 1949 and it was impossible to take valid quantitative data on the treatments. However, it was observed that both cherry seedlings and weeds made much more vigorous growth in the chloropicrin-treated plots than in the untreated plots. Examination of roots of plants from the treated and untreated plots revealed none to few nematodes in the roots of the vigorously growing plants from the former and much heavier infestation of roots of plants from the latter. This apparent relation of root infestation and reduction of growth was especially evident on Mazzard cherry and lamb's quarter (Chenopodium album). In greenhouse tests Mazzard seedlings planted in naturally infested nursery soil were greatly retarded in growth as compared to seedlings grown in sterilized soil.

During July and August of 1949 various plants were collected from a field in which severe retardation of growth of Mazzard seedlings and lining-out stock had been observed in 1946, 1947, and 1948. Both weed and forage crop plants were collected from the field, which was planted with a mixture of clover and perennial rye grass, and the roots were stained and observed for the presence of meadow nematodes. Results of the observations are shown in Table 1.

Preliminary tests were conducted in the greenhouse to determine the susceptibility to meadow nematode infestation of several cover crops commonly used in nursery rotations. Seeds of eight kinds of plants were planted in infested soil. Two weeks after emergence the seedlings were removed, their roots stained and subsequently examined. Roots of creeping red fescue, alta fescue, perennial rye grass, common rye grass, crimson clover, and hairy betch were infested with meadow nematodes. No nematodes were observed in roots of Austrian winter field peas and common vetch.

Reduction in growth of a number of plants as a result of meadow nematode infestation has been reported (1). From the foregoing observations and tests it would appear that the meadow nematode is an important factor in the retardation of growth of Mazzard cherry seedlings and lining-out stock in one area in Oregon. It must now be determined whether the meadow nematode is the primary factor in this condition or is only a contributing factor in a root rot complex such as has been reported on other crops (1, 2, 4). If the meadow nematode, upon further investigation, should prove to be the primary cause of the retardation of growth of Mazzard cherry seedlings control will be complicated by the wide host range and the wide shipment of nursery stock.

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[2]Identification by Dr. W. H. Courtney, Associate Nematologist, Division of Nematology, U. S. Department of Agriculture, and by Dr. M. W. Allen, Assistant Nematologist, University of California, Berkeley.

Table 1. Relative degree of meadow nematode infestation of plants from nursery cover crop following Mazzard cherry.

| Name of Plant | Number of Samples Observed | Infested | Degree of Infestation |
|---|---|---|---|
| Alsike clover, (Trifolium hybridum L.) | 3 | 3 | Heavy |
| Crimson clover, (Trifolium incarnatum L.) | 2 | 2 | Heavy |
| Hairy vetch, (Vicia villosa Roth.) | 2 | 2 | Light |
| Oats, (Avena sativa L.) | 2 | 2 | Moderate |
| Perennial rye grass, (Lolium perenne L.) | 5 | 4 | Light |
| Bachelor's button, (Centaurea cyanus L.) | 3 | 3 | Light |
| Black bindweed, (Polygonum convolvulus L.) | 2 | 2 | Moderate |
| Black locust, (Robinia pseudoacacia L.) | 1 | 1 | Light |
| Brewer's bitter cress, (Cardamine breweri Wats.) | 1 | 1 | Moderate |
| Common chickweed, (Stellaria media (L.) Cyr.) | 3 | 2 | Moderate |
| Dog fennel, (Anthemis cotula L.) | 3 | 2 | Heavy |
| Lambs quarter, (Chenopodium album L.) | 7 | 7 | Heavy |
| Radish, (Raphanus sativus L.) | 2 | 1 | Moderate |
| Tall blue lettuce, (Lactuca spicata (Lam.) Hitchc.) | 1 | 1 | Light |
| Yellow mustard, (Brassica campestris L.) | 3 | 2 | Light |

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OREGON AGRICULTURAL EXPERIMENT STATION AND OREGON STATE DEPARTMENT OF AGRICULTURE, CORVALLIS

## SMALL GRAIN DISEASES IN NEBRASKA IN 1950

J. E. Livingston

Two distinctive root rots affected wheat in Nebraska this year. Take-all (Ophiobolus graminis) caused slight to moderate damage in the southeastern quarter of the State. Even so, it was the most serious outbreak of take-all that the writer has seen in Nebraska. Many isolated dead plants could be found scattered through most fields, and frequently irregular areas of dead plants from 15 to 25 feet in diameter could be found. Usually not more than two or three of these large areas occurred in any single field.

A different type of root rot was found in many fields in the panhandle of western Nebraska resulting in a 10 to 20 percent reduction in stand. Death of the plants occurred in early April. The remaining plants appeared to be unaffected. The cause of this root rot was not determined; however, in 1949 a somewhat similar condition was caused by a species of Fusarium that has been isolated and proven pathogenic. There was a direct relationship between the date of planting and the amount of this root rot in winter wheat. Wheat planted around the 26th to the 28th of August invariably showed more root rot than wheat planted around the 10th of September. In one instance half of the field was planted on August 26 and showed a 30 percent reduction in stand while the other half, planted on September 8, had nearly a perfect stand. Field observations over a period of years indicate that avoiding early planting and planting in a good firm seed bed are very desirable in avoiding this disease.

Leaf rust (Puccinia rubigo-vera var. tritici) and stem rust (P. graminis) of wheat were present but of no importance. Loose smut (Ustilago tritici) was present in approximately 50 percent of the fields with as many as 5 percent of the heads affected in some fields.

Bunt (Tilletia spp.) was of no consequence in wheat, having returned to the status of a minor pest following the initiation of a State-wide seed treatment program in 1945.

A moderate amount of crown rust (Puccinia coronata) and stem rust developed on susceptible oats in the southeastern portion of the State. It appeared about 10 days too late to be damaging. Victoria blight (Helminthosporium victoriae) caused only slight damage in susceptible varieties. However, most of the State acreage is planted to resistant varieties.

Long water-soaked lesions on the leaves of oats and wheat, presumably caused by Pseudomonas striafaciens and Xanthomonas translucens f. sp. undulosa, respectively, were very prevalent, causing considerable yellowing and dying of the leaves.

NEBRASKA AGRICULTURAL EXPERIMENT STATION

## ASCOCHYTA SEEDLING BLIGHT OF COTTON IN ALABAMA IN 1950

A. L. Smith

Ascochyta gossypii has caused considerable seedling and small plant losses in Alabama since 1947. Losses from stem canker and leaf blighting of older plants and boll rotting have been observed but have not been considered as serious. Seedling and small plant losses were sporadic or locally epidemic from 1947 to 1949, but became general in the northern third of the State in 1950. A survey of that area was made June 12 to 16. Losses were greater in the northeastern part of the State, particularly in DeKalb, Jackson, Madison, Marshall, Calhoun and Etowah Counties. In DeKalb County where losses were serious, most stands were reduced by Ascochyta blight. About 2 percent of the acreage was plowed up because of poor stands, although good original stands were obtained. Many stands were reduced to 50 to 70 percent. The epidemic nature of the disease in this area is attributed to frequent local showers and prolonged cool weather, rather than to an excessively heavy or extended rain period.

The loss of plants and disease intensity varied widely from field to field, depending upon the cultural practices followed and the preceding crop. Cotton following other crops, mostly corn, showed very light infections, usually with spots confined to the cotyledons and no loss of stand from Ascochyta. In other fields with cotton following cotton, the severity of the disease appeared proportional to the amount of old plant material, stalk and branches, remaining on the surface of the soil. At this time all leaf material was decayed. The old plant material from the previous cotton crop was obviously the major source of inoculum. Fall or spring plowing, if deep with flat planting and without working stalks to the surface, gave partial control. Fall disking likewise showed some control benefits, although generally unsatisfactory. Greatest losses occurred where cotton stalks were left standing or were cut and left on the surface over winter; in either case they were not plowed under but were largely left on the surface at time of preparing the land for planting. In this area it is a common practice to plant vetch in cotton fields and leave the stalks standing over winter.

### Seed Transmission, Symptoms, and Spread

Evidence obtained confirms observations of others (7) that Ascochyta is readily seed-borne. Seedlings from untreated seed planted in fields following corn showed as much as 100 percent infection on cotyledons taken from consecutive plants. Seed treatment and/or source of seed resulted in much lower percentages of infection in other rotated fields. In all cases sufficient Ascochyta leaf spots were observed to reinfest all plantings, and, consequently, planting cotton following other crops would be of definite control value for only the current season. Seed-borne inoculum alone does not appear important in causing seedling losses. The period of time necessary for development of the disease on cotyledons infected only from seed is apparently sufficient to delay the reinfection of leaves higher up on the plant long enough to allow escape of seedlings of the current season. In other words, seedling losses resulted only from multiple infections originating largely from rain-splashed, soil-borne inoculum.

First symptoms of the disease are small round white purple-ringed spots on the cotyledons and lower leaves. These spots enlarge to become somewhat elongated and raised on the upper surface; later these change to a light brown color. The purple ring around the outside disappears and the diseased tissue often falls out. Where numerous infections occur, irregular large diseased areas result, followed by drying and shedding of cotyledons and lower leaves. Pycnidia are produced irregularly or in concentric rings and are visible on the upper surface. Growth of plants is stunted, internodes are shortened, leaves become smaller and the upper small leaves, petioles, and buds are often infected followed by killing of the plant. The almost bare stems with a few small leaves at the tip are characteristic of the disease at later stages. The previously described (4, 6) girdling of stems from stipule infections at the leaf axils on somewhat larger plants was a minor factor in 1950 in relation to stand losses. The current losses occurred commonly on small seedlings or plants up to 6- or 8-leaf stages, and resulted primarily from involvement of cotyledons, leaves, petioles, and buds. With more favorable weather and growing conditions, the plants often escaped with the loss of one to several leaves or cotyledons.

Field spread of the disease appears quite limited except by seed-borne inoculum. Other than by purely mechanical movement of old plant parts, local spread appeared mainly by flow of surface water from contaminated fields to lower lying areas.

## Varietal Resistance

Speculation on the causes of the relatively recent recurrent epiphytotic nature of Ascochyta blight in Alabama and other southeastern States might lead to the conclusion that Stoneville and Stoneville-derived varieties are responsible. These varieties, which include Stoneville 2B, Coker 100 Wilt, Empire, Stonewilt, White Gold, and Plains, make up approximately 75 to 95 percent of the plantings in different areas of this region. However, this conclusion is invalid. Observations of 25 varieties in two variety tests indicate all varieties were quite susceptible in the seedling stage. Similar observations were made in 1949 in Georgia by Morey and Miller (5) on field plantings of several varieties. Although minor differences could be seen, no variety appears to have sufficient resistance to be of much value in preventing seedling losses. Empire (2) was shown to have resistance in older plants, and in the above-mentioned tests, it appeared slightly less susceptible in the seedling stage than some other varieties. Good seedling vigor was a partial means of escape in some varieties. Late-planted fields usually escaped with less severe infections and usually with no loss of stand from Ascochyta when compared with nearby early planted fields.

## A Common Name for Ascochyta Blight

The epidemic nature of Ascochyta blight has necessitated the publicizing of information about the disease. Ascochyta is difficult to pronounce and spell and consequently a common name for the disease is needed. Higgins (4) used the term "wet weather canker" to describe the predominating stem phase occurring in late June. The present outbreak may be more accurately described as a "leaf blight" and growers refer to it as such. The writer suggests "wet-weather blight" as a common name. This name appears general enough to cover all phases of the disease.

## Control

Planting cotton following other crops is a very effective and practical control measure for the seedling and small plant phases of Ascochyta blight. The writer's observations confirm Elliott's suggestion (3) and the observations of others (4, 5) concerning control by rotation. The control benefit of rotation would last only for the current season, making it necessary for cotton to follow other crops each year. An estimated 80 percent of the Alabama cotton crop follows cotton and some difficulty may be anticipated in changing this practice; consequently, a wide search should be made for resistance to Ascochyta. As a control measure, Arndt (1) suggested plowing under cotton stalks early enough to cause complete rotting before planting time. The writer's observations indicate that some measure of control was obtained in several instances by plowing under cotton stalks as quickly after harvest as possible to obtain maximum decay. If plowing is not possible, disking in the fall or the use of other methods such as deep spring plowing and flat planting to reduce the amount of plant material on the surface at time of planting will give partial control and may prevent the loss of stands.

## A Widespread Epidemic Always Possible

Ascochyta blight symptoms were found on practically 100 percent of the cotton plants in all fields observed where cotton followed cotton in an area involving the northern half of the State. Diseased specimens mailed to Auburn from several southern Alabama locations suggest that the same situation probably existed in the remainder of the State. The widespread and complete distribution of this disease makes possible an epidemic wherever weather conditions become favorable for its development. Rotation of the cotton crop with other crops is a simple and effective control measure that can entirely prevent any further stand losses.

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DEPARTMENT OF AGRONOMY AND SOILS, ALABAMA AGRICULTURAL EXPERIMENT STATION; AND DIVISION OF COTTON AND OTHER FIBER CROPS AND DISEASES, U. S. DEPARTMENT OF AGRICULTURE, AUBURN, ALABAMA. June 29, 1950.

## THE ROLE OF FRESH-MARKET TOMATO FRUITS IN THE DISSEMINATION OF PHYTOPHTHORA INFESTANS

W. J. Martin

In Louisiana late blight was not reported on fall crops of potatoes and tomatoes in 1949, nor on the spring crop of potatoes in 1950. Although agricultural officials and growers in the State were on the alert for outbreaks of late blight, none was observed.

However, on June 1, 1950, late blight was observed in a small tomato planting near Lockport in Lafourche Parish by John A. Cox, Extension Horticulturist, Louisiana State University. Apparently the disease had started in this planting at least 10 days previously. Most of the spring crop of potatoes in this area had been harvested in early April.

Since late blight had not been reported on the 1950 spring crop of potatoes, this outbreak on tomatoes was somewhat unexpected, and particularly so since indications are that all tomato plants for that area in Lafourche Parish are locally grown. Therefore a search was made for possible sources of infection for this outbreak of late blight.

On June 2, 1950, a few tomato fruits on the local market in Baton Rouge, Louisiana, were observed as having rather typical late blight symptoms. These tomatoes had been packed and shipped out of Produce, Florida which is in the Tampa Bay area. A typical bloom of Phytophthora infestans was obtained on certain of the above fruits when they were kept in a moist chamber at 20° C. for 24 to 30 hours. Local vegetable distributors stated that tomato fruits from that area of Florida had been distributed in the State since mid-April, perhaps earlier.

On June 5, the late blight-infested planting near Lockport was visited by the writer. The planting consisted of 700 plants and was beginning to come into production. It was located directly in front of and 45 feet from, the entrance of a roadside vegetable stand. The owner of the vegetable stand stated that he had been retailing tomato fruits from the Tampa Bay area of Florida since April 27.

Late blight-affected fruits were found in Florida-grown tomatoes in retail stores at Lockport, Thibodeaux, and Napoleonville, Louisiana on June 5. The fungus grew readily on these fruits when they were placed in moist chambers at 20° C. for about 24 hours.

The above observations on the development of late blight in Louisiana in 1949 and 1950, along with the observation of viable Phytophthora infestans on imported tomato fruits, suggest the possibility of the dissemination of Phytophthora infestans via affected, fresh-market tomato fruits.

DEPARTMENT OF PLANT PATHOLOGY, LOUISIANA AGRICULTURAL EXPERIMENT STATION, BATON ROUGE, LOUISIANA

## CONTROL OF DAMPING-OFF WITH 8-QUINOLINOL

E. M. Stoddard[1] and G. A. Zentmyer[2]

For a number of years 8-quinolinol compounds have been used at the Connecticut Agricultural Experiment Station for the control of damping-off of seedlings in the routine of growing experimental plants. This practice was initiated as the result of trials of various materials which showed promise in chemotherapy tests on other diseases (1, 2).

The use of 8-quinolinol and its derivatives introduces a new series of chemicals into the field of damping-off control. This paper briefly reports some of the greenhouse experiments with these materials. 8-quinolinol, and its benzoate and sulfate salts have given control of both pre- and post-emergence damping-off. Trials have been conducted with spinach, peas, eggplant, lettuce, petunias, snapdragons, celery, tomatoes, and elms.

The results of experiments for control of pre-emergence damping-off of peas are indicative of the striking results with these materials, (as shown in Table 1.) Three other tests with peas gave closely similar results. In these tests the dry chemicals were mixed with the soil in pots before planting the seed.

In this test, as in several others, there was indication of chemical injury at the higher dosage-levels. Injury was evidenced by retarded rate of emergence, lower total emergence, and occasionally by slight chlorosis of leaves when solutions were applied to seedlings following emergence.

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[2]University of California, Riverside, California.

Table 1. Control of damping-off of peas with 8-quinolinol compounds.[a]

| Material | Dosage per 940 grams of soil | Percent emergence |
|---|---|---|
| 8-quinolinol benzoate | 1 gram | 84 |
| do. | 2 grams | 92 |
| do. | 4 grams | 72 |
| do. | 6 grams | 64 |
| 8-quinolinol sulfate | 1 gram | 20 |
| do. | 2 grams | 84 |
| do. | 4 grams | 84 |
| do. | 6 grams | 24 |
| Check | -- | 4 |
| Check | -- | 0 |

[a]Twenty-five seeds planted per pot; final data taken 15 days after planting. Naturally-infested soil, with both Pythium and Rhizoctonia present.

Trials with lettuce, spinach, petunia, snapdragon, and celery seedlings have shown that the 8-quinolinol materials also are definitely useful for control of post-emergence damping-off, when applied to seedlings in aqueous solutions. Further details of this work will be published elsewhere.

Literature Cited

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## A SIMPLE DEVICE FOR COLLECTION OF FUNGUS SPORES

Ian W. Tervet and E. Cherry

A report was given at the Potomac Division meetings of the American Phytopathological Society in March 1950 on a method for the collection of fungus spores[1]. The method involved the use of cyclone separators for the deposition of spores from an air stream. A paper on the use and construction of cyclones for spore collection is in manuscript, but publication is not expected for several months. Several requests have been made recently to the author (of the report given above) for plans of construction of the cyclone separator described. Thus, it seems advisable now to publish a note on the apparatus and to give instructions for the construction of a simple model from materials available in any laboratory.

A cyclone separator can be constructed from a centrifuge tube or a test-tube, a rubber stopper and two pieces of glass tubing. When using a 50 ml. long cone point centrifuge tube, a No. 5 rubber stopper is fitted with the two pieces of glass tubing. A straight piece of glass tubing projects about 2.5 cm. centrally into the centrifuge tube, while the second glass tubing, bent at right angles, projects about 1.5 cm. into the tube. It is important that the straight glass tubing terminates below the bent glass tubing (See Fig. 1).

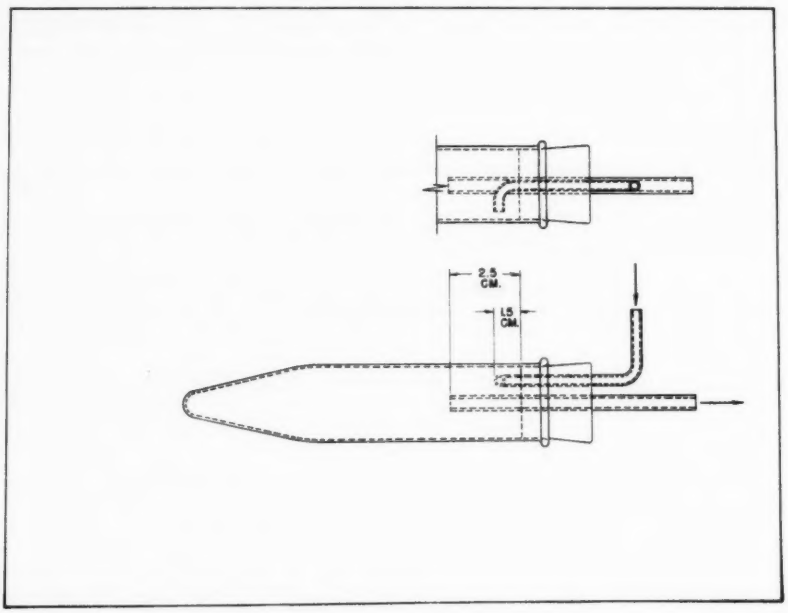


Figure 1. - Diagram of cyclone separator

For spore collection, suction is applied by means of a vacuum pump to the centrally located glass tube, while the orifice of the other tube is directed over the surface of a leaf or other plant part or artificial substrate on which spores are being produced. The spores collect at the bottom of the centrifuge tube. It is possible to use the collector as a duster by reversal of air flow.

CAMP DETRICK, FREDERICK, MARYLAND

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[1]Tervet, Ian W. A technique for the collection of dry spores from infected plants. Phytopath. (Abstr.) (In press).

## PLANT DISEASE REPORTER

Actual experience with the new method of processing the Plant Disease Reporter requires some slight revision of the suggestions for manuscript preparation made before we really knew what was demanded in cost and labor and before we had worked out procedure (PDR, Nov. 15, p. 408-409).

This method of publication is much more expensive than mimeographing. Taking into account not only the per page costs for reproduction, but also the time involved for the small Survey staff in various operations, we finally decided on our present format as best.

By far the greatest part of the cost is in the preparation of the plates. To keep the number of plates as low as possible we are typing a wider and longer page which undergoes a 25 percent reduction in photographing. This is true for text and figures, except that large figures, of course, require greater reduction to bring them into Reporter page size.

Drawings and photographs should preferably be unmounted so that we can place them properly in relation to the text. Not all photographs reproduce well by this method; the essentials are clear focusing, good contrast, and not too dark a print.

Since multilithing takes somewhat longer, deadline for manuscript for individual numbers has been moved up to the 15th of the month preceding date of issue, to give us a little more time for preparation.

Back numbers of the Plant Disease Reporter and its supplements are in almost continual demand by libraries and investigators located at a distance from large libraries. It would assist us in filling these requests if anyone having copies not desired for his own files would return them to the Plant Disease Survey.

If you keep a file of these for your own use or clip them, we are, of course, glad of that much interest, but if you discard your copies after reading them please put them in the mail to us instead of in the waste basket.

## BRIEF NOTES ON PLANT DISEASES, AND A CORRECTION

### A PROMISING FUNGICIDE-PLANT FOOD COMBINATION FOR APPLE SCAB CONTROL

By P. L. Poulos and J. W. Heuberger

In a compound evaluation test for control of apple scab on the Rome variety at West Dover, Delaware, Magnetic 70 Paste type sulfur + NuGreen, which contains urea, showed promise as an effective fungicide-plant food combination for the control of scab. Primary infection data on foliage were taken June 5.

Foliage scab, Rome variety; West Dover, Delaware - 1950

| Treatment[a] | Conc. per 100 gal. | Percent foliage scab |
|---|---|---|
| 1. Untreated | --- | 45.0 |
| 2. Magnetic 70 Paste type sulfur[b] | 8 lbs | 8.5 |
| 3. Magnetic 70 Paste type sulfur + NuGreen[c] | 4 lbs + 5 lbs | 0.7 |

[a]Applications: Delayed Dormant, Pre-Pink, Pink, Full Pink, Bloom and Petal Fall.
[b]Used at all applications.
[c]Mag. 70 (8 lbs-100) only at Delayed Dormant, Pre-Pink, and Bloom.
Mag. 70 + NuGreen (4 lbs + 5 lbs - 100) at Pink, Full Pink and Petal Fall.

These data are in accord with those reported by Stoddard. (Stoddard, E. M. Fungicidal synergism between urea and sulfur. Abst. Phytopath. 40 (1): 27. 1950).

UNIVERSITY OF DELAWARE, NEWARK

## CONNECTICUT DISEASE NOTES

By Saul Rich and Ernest M. Stoddard

On June 21, a half-acre of onions being grown for sets was found to be 100 percent infected with downy mildew (Peronospora destructor). The field, located just north of Hartford, had been used repeatedly for growing onions. At the time of examination, the leaves were completely gone, the stalks were severely infected, and there was abundant conidial production. This is the first Connecticut report of such a heavy infestation of this disease in the past eleven years.

In spite of a very early discharge of ascospores this spring, apple scab (Venturia inaequalis) has become serious, particularly on McIntosh apples. This condition was caused by a period of warm, wet weather during the last half of May. Puratized Apple Spray and materials of a similar nature are being used extensively to alleviate the situation. Other apple diseases which are more prominent this year than in other seasons are cedar-apple rust (Gymnosporangium juniperi-virginianae) and black rot (Physalospora obtusa).

E. C. Minnum, Extension Vegetable Specialist, reports 8 to 10 percent infection of big-vein (virus) in Connecticut lettuce plantings. Lettuce downy mildew (Bremia lactucae) made a sporadic appearance again this spring. The mildew attacked the young plants in cold frames just prior to the time of setting out.

The prolonged wet weather also started a general outbreak of Botrytis, which appeared on tulips, forsythia, peony buds, and the old blossoms of dogwood and lilac.

The effects of last summer's drought showed up this spring in many evergreens, which developed brown needles. Most of the brown needles were eventually lost.

CONNECTICUT AGRICULTURAL EXPERIMENT STATION, NEW HAVEN

## EARLY DEVELOPMENT OF RHUBARB LEAF SPOT IN NEW YORK

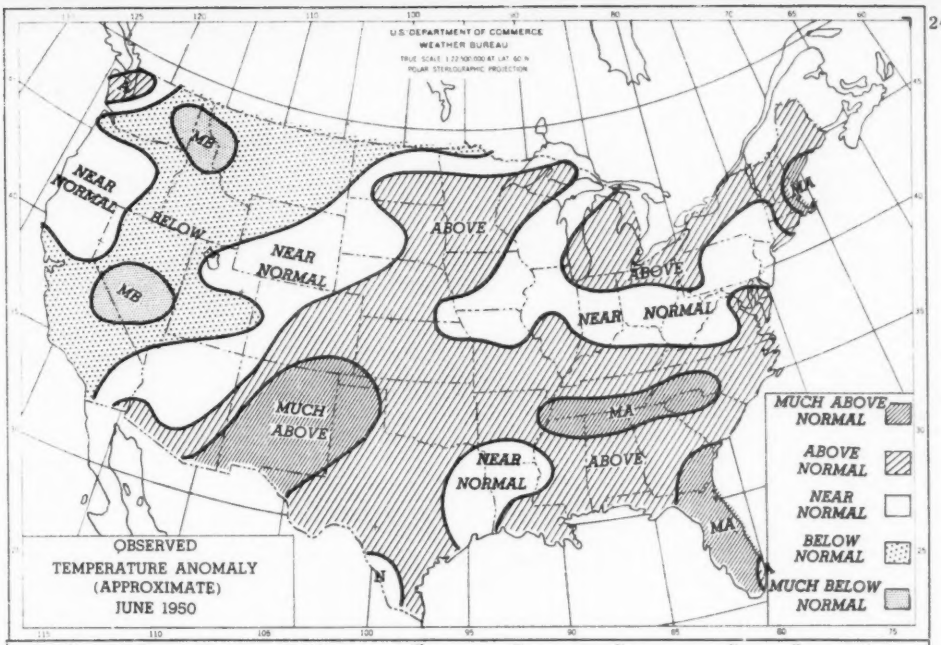
By Charles Chupp

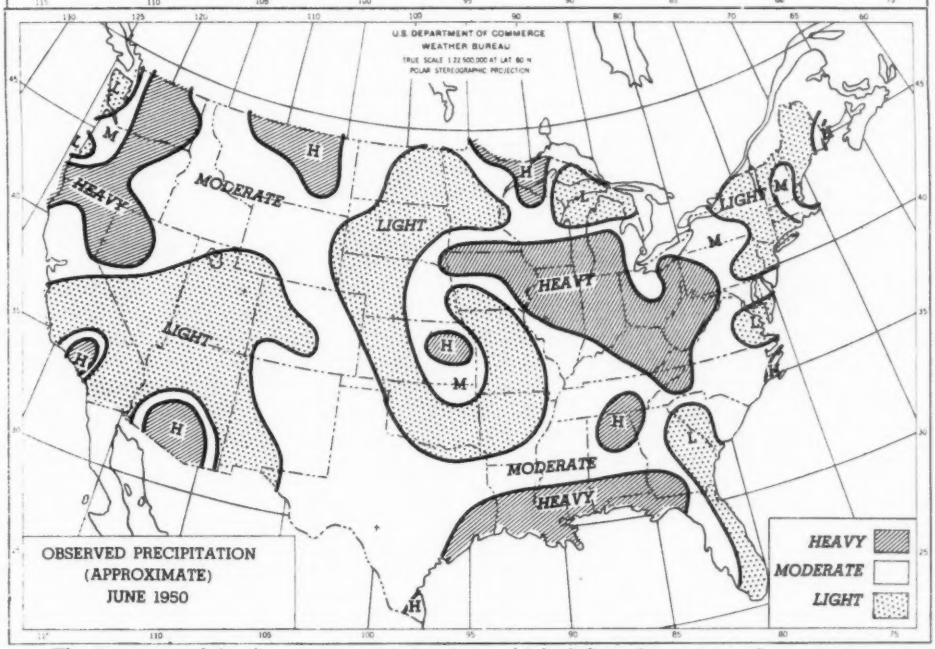
The Ascochyta leaf spot of rhubarb developed earlier this year than my records show for any previous season. Not only are the leaves affected but the disease is serious enough to spot the stems. This is the same fungus which had formerly been named Phyllosticta straminella. Whether the early appearance is due to the heavy rains or the unusually cool weather has not yet been determined.

CORNELL UNIVERSITY, ITHACA, NEW YORK. June 15.

## A CORRECTION: SUPPLEMENT 193

Although we believe that the Reporter, for the most part, attains a high degree of accuracy, nobody knows better than the Survey itself how far we are from perfection. We had thought that our latest monumental publication had almost reached this goal, so that it was all the more a shock to discover that four illustrations had been placed on their sides. When you consult Supplement 193, "Plant Disease Losses: Their Appraisal and Interpretation" by K. Starr Chester, please remember that Figure 7 on page 236, Figure 17 on page 251, Figure 24 on page 311, and Figure 27 on page 321, have all been printed so that what should have been the top of the graph became the right-hand side. Thus, the lower edge for Figure 7 should be "Age of stand, years"; for Figure 17 "Age of basal wound (years)"; for Figure 24 the description of stages in development; for Figure 27 "Leafroll, %." In all cases the proper position is obvious after the first glance, but we regret the error in placement.




The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time. Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

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